Operating Instructions

TTO OFFICE | 1003 C

3c/s to 100kc/s PRE-AMPLIFIER

Type TM 6591

105/CA 801

MARCONI INSTRUMENTS LIMITED, ENGLAND

MP MASTER
MA23715

OPERATING INSTRUCTIONS

No. EBM 6591

for

3-c/s to 100-kc/s PRE-AMPLIFIER

TYPE TM 6591

AMENDMENTS, if any, are included at the end of the handbook.

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DRAWINGS	Ref. No.
COMPLETE CIRCUIT DIAGRAM	XD 35176
COMPONENTS LIST	XD 35176 (2 sheets)
FUNCTIONAL DIAGRAM	TLC 35865

M. I. Ltd.

SCHEDULE OF PARTS SUPPLIED

The complete equipment comprises the following items :-

1. One Pre-amplifier Type TM 6591 complete with transistors, battery, etc. as under :-

Transistors:	One: Type OC201, Silicon Transistor. Four: Type OC44, Germanium R. F. Transistors.
Battery:	One: 22½-volt, Ever-Ready Batrymax "B", Type B115. (Not supplied with export models.)

2. Two plugs, Belling-Lee Type L378/3 (one red and one black).

3. One Instruction Book No. EBM 6591.

DATA SUMMARY

for

3-c/s to 100-kc/s PRE-AMPLIFIER, TYPE TM 6591

Serial No. JA 939/001 and above

FREQUENCY RANGE:	3 c/s to 100 kc/s (-3 dB) when used with TF 1330 Oscilloscope.
GAIN:	x100 ±5%. x10 ±5%. Accurate adjustment obtainable by internal preset control.
MAXIMUM INPUT:	x100 range: 50 mV peak-to-peak. x10 range: 500 mV peak-to-peak.
INPUT IMPEDANCE:	Approximately 10 MΩ with 25 μμF in shunt.
NOISE:	Equivalent noise voltage, with 1 MΩ across input, approximately 100 μV r.m.s.; with input short-circuited approximately 35 μV r.m.s.
POWER SUPPLY:	22½-volt, Ever-Ready Batrymax "B" battery, Type B115.

DIMENSIONS & WEIGHT (including battery):

Height	Width	Depth	Weight
2¾ in (7 cm)	4½ in (11.4 cm)	3 in (7.6 cm)	1 lb 3 oz (540 gm)

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1 INTRODUCTION

The 3-c/s to 100-kc/s Pre-amplifier Type TM 6591 provides voltage amplification of 10 or 100 times. It is intended for use with a Marconi Oscilloscope Type TF 1330, or with any other suitable oscilloscope. Fully transistorized, the Pre-amplifier increases the sensitivity of an oscilloscope over the a.f. range and well into the ultrasonic region. When used with a Type TF 1330 Oscilloscope the maximum sensitivity of the latter is increased to 500 μV/cm and, because the Pre-amplifier has a high input impedance, the loading of the circuit under test is reduced by a factor of approximately 10 to 1.

The Pre-amplifier may also be used to increase the sensitivity of a valve voltmeter or other a.c. voltmeter having a high input impedance.

Used in conjunction with a suitable oscilloscope, the virtual absence of hum and microphony permits clear and steady displays of low-level waveforms from low-impedance sources. The circuit incorporates special design features to minimize loop-earth potentials, thus making it particularly suitable for tracing sources of mains hum at very low levels.

Powered from a $22\frac{1}{2}$-volt internal battery, the unit is completely self-contained; alternatively, it may be operated from an external d.c. supply.

2 OPERATION

2.1 INSTALLATION

The instrument is normally dispatched with its dry battery in position, ready for immediate use. On export models, however, the battery is not included; this is to prevent any seepage that might occur under adverse transit conditions. For details of the removal and replacement of the battery, refer to Section 4.3.

2.2 SWITCHING ON

Since the instrument is fully-transistorized, its warming-up time is negligible and it is ready for immediate use after switching ON the BATT. switch.

2.3 CONNECTION TO OSCILLOSCOPE

To connect the Pre-amplifier between the signal source to be amplified and the oscilloscope proceed as follows :-

(1) Connect the 3-ft coaxial output lead on the Pre-amplifier to the Y-input on the oscilloscope.

(2) Connect the output from the circuit under test to the INPUT sockets on the Pre-amplifier. (The black socket denotes the "earthy" connection.)

(3) Set the oscilloscope to operate at its most sensitive condition.

(4) Select the degree of Pre-amplifier gain required, by sliding the GAIN switch to x10 or x100.

(5) Switch ON the Pre-amplifier by means of the BATT. switch.

Note: The input circuit is protected by d.c. isolating capacitor and a 100-kΩ resistor in series. The maximum d.c. potential that may be applied to the INPUT sockets is limited to 350 volts.

3 TECHNICAL DESCRIPTION

It is recommended that the following sections be read in conjunction with the Functional Diagram and the complete Circuit Diagram included at the end of this handbook.

3.1 CIRCUIT DETAILS

The circuit employs five transistors. The first and second transistors, VT1 and VT2, are connected as cascaded direct-coupled emitter followers. The emitter output from the first amplifier, VT3, is a.c. coupled to the collector of the first transistor, VT1, whose collector and base are therefore maintained at near equal signal potentials. Since the signal potential difference across resistor R2, connected between the collector and the base of VT1, is nearly zero volts the input impedance to the amplifier is maintained at a high value (several times that of the ohmic value of resistor R2).

A 0.1-μF capacitor and a 100-kΩ resistor are connected in series with the input circuit. The capacitor isolates the input circuit and permits d.c. voltages up to 350 volts to be applied to the INPUT sockets. The 100-kΩ series resistor is included to limit the a.c. current at supply frequency, should the instrument be accidently connected to the supply mains.

The amplified signal at the collector of the first amplifier stage, VT3, is applied either direct - or through a fixed 10:1 potentiometer - to the emitter follower stage VT4. The potentiometer provides signal amplification of either ten or one hundred times, according to the position of the GAIN switch, SA.

The final amplifier stage VT5 is preceded by the emitter follower VT4 in order to minimize the loading on the first amplifier and its associated 10:1 potentiometer. Output from the Pre-amplifier is obtained from the collector circuit of the final amplifier via the capacitor C7.

3.2 EARTH-LOOP CURRENTS

The earth, or battery negative, of the instrument is isolated from the braiding on the coaxial output lead by a 22-ohm resistor, R13. This resistor ensures that potentials resulting from earth-loop currents appear across R13 - the voltage drop in the leads becoming negligible. In this way, they are not amplified by the Pre-amplifier.

3.3 POWER SUPPLIES

Power for the instrument is derived from a $22\frac{1}{2}$-volt dry battery. A two-pole BATT. ON/OFF switch, SB, completely isolates the battery from the circuit in the OFF position.

For details of the removal and replacement of the battery, refer to Section 4.3.

4 MAINTENANCE

4.1 GENERAL

Before adjustment or replacement of any component part of the instrument, it is recommended that you become familiar with the circuit description given in Section 3.

To further assist you, a Functional Diagram and a Circuit Diagram are included at the end of this handbook.

4.2 REMOVAL OF CASE

The two sides and the base of the instrument are formed in one piece; this is secured in position by two 4-BA screws. To get at any component part of the instrument, remove these two 4-BA screws and, holding the base uppermost, slide the two sides and base clear of the instrument. The battery should now be visible in position in its plastic container; the container, complete with battery, may be lifted from the instrument to obtain access to the reverse sides of the two printed-circuit boards.

When the instrument case and the battery container have been removed, all components in the instrument are immediately accessible.

4.3 BATTERY REPLACEMENT

The Pre-amplifier is transistorized throughout and, due to its extremely low current consumption, it is not anticipated that the batteries will require frequent replacement. From time-to-time, a falling off of gain in the instrument will indicate that battery replacement is necessary. Two BATT. CHECK sockets are provided at one end of the instrument case for monitoring the battery voltage; this should be carried out when the Pre-amplifier is switched on. The battery should be replaced when the voltage has fallen below 18 volts.

4.3 (continued)

The instrument is normally supplied with one $22\frac{1}{2}$-volt dry battery (Ever-Ready Batrymax "B" battery, Type B115). To remove this battery, proceed as follows :-

(1) Lay the Pre-amplifier face downwards.

(2) Remove the case, and the battery container, as described in Section 4.2.

(3) Lift the battery from its container and remove the non-reversible 2-pin plug.

To fit the replacement battery reverse the above procedure.

Note: Serious damage to the transistors will result if the battery polarity is incorrect. If the wiring to the plug has to be renewed for any reason and there is any doubt as to the correct polarity, check the wiring against the circuit diagram.

4.4 REPLACEMENT OF SEMICONDUCTORS

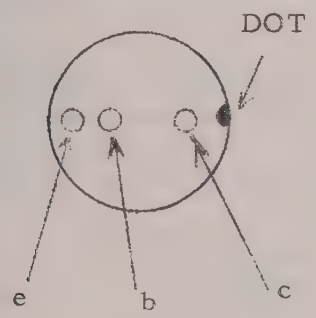
This section gives details of the replacement of the semiconductor devices used in the instrument.

When removing or replacing semiconductors, it is recommended that a thermal shunt be used. This can easily be made by soldering copper blocks within the jaws of a small crocodile clip. The thermal shunt should be clipped over the lead-out wire between the component and the hot soldering iron.

Unlike thermionic valves whose performance gradually deteriorates with age until replacement eventually becomes necessary, transistors may be regarded as having an almost infinite life, provided they are not subjected to incorrect operating conditions. The necessity for transistor replacement is therefore extremely unlikely and, should such an event occur, the failure can almost always be attributed to component breakdown in some other part of the circuit.

4.4 (continued)

Special selection of replacements for any of the transistors in the instrument is not required. When fitting a replacement transistor, it is important that the leads should not be bent nearer than 1.5 mm from the seal, also, since transistors are inherently sensitive to incident illumination care should be taken to ensure that the external coating of black paint is not scratched or damaged.



The collector lead-out wire of the Type OC44 transistor is marked with a red spot; the collector lead-out wire of the Type OC201 transistor is marked with a white spot. The emitter lead, is diametrically opposed to the collector lead, with the base connection in the middle. If the red spot, or the white spot, cannot be distinguished, the collector lead may still be identified by the position of the base lead which is slightly offset towards the emitter connection (see sketch).

4.5 ADJUSTING GAIN

The gain of the Pre-amplifier may be set by RV1 to exactly ten or one hundred times, according to the position of the GAIN switch. If the gain is accurately set at the x10 switch position, the gain will be correct within ±2% for the x100 switch position, and vice versa.

To make an adjustment, proceed as follows :-

(1) First remove the instrument case as described in Section 4.2.

(2) Connect a signal generator set to produce a 1-kc/s signal, at a convenient level, to a fixed potentiometer with a ratio of exactly 10:1 and a total impedance of about 1,000 ohms.

(3) Connect the Pre-amplifier INPUT sockets to the potentiometer to give an amplifier input of 1/10th of the signal generator output.

4.5 (continued)

(4) Switch the BATT. switch, on the Pre-amplifier to ON, and the GAIN switch to x10.

(5) Alternately measure, with a sensitive valve voltmeter, the signal voltages at the signal generator and the Pre-amplifier outlets.

(6) Adjust the variable resistor RV1 until the two voltage measurements in (5) above are identical.

(7) Replace the instrument case.

Notes: (i) If a sensitive valve voltmeter is not available, a suitable oscilloscope may be used to give the indication required in (5) and (6) above.

(ii) The accuracy of the gain adjustment will depend largely upon the accuracy of the 10:1 potentiometer used in the setting up procedure.

4.6 WORKING VOLTAGES

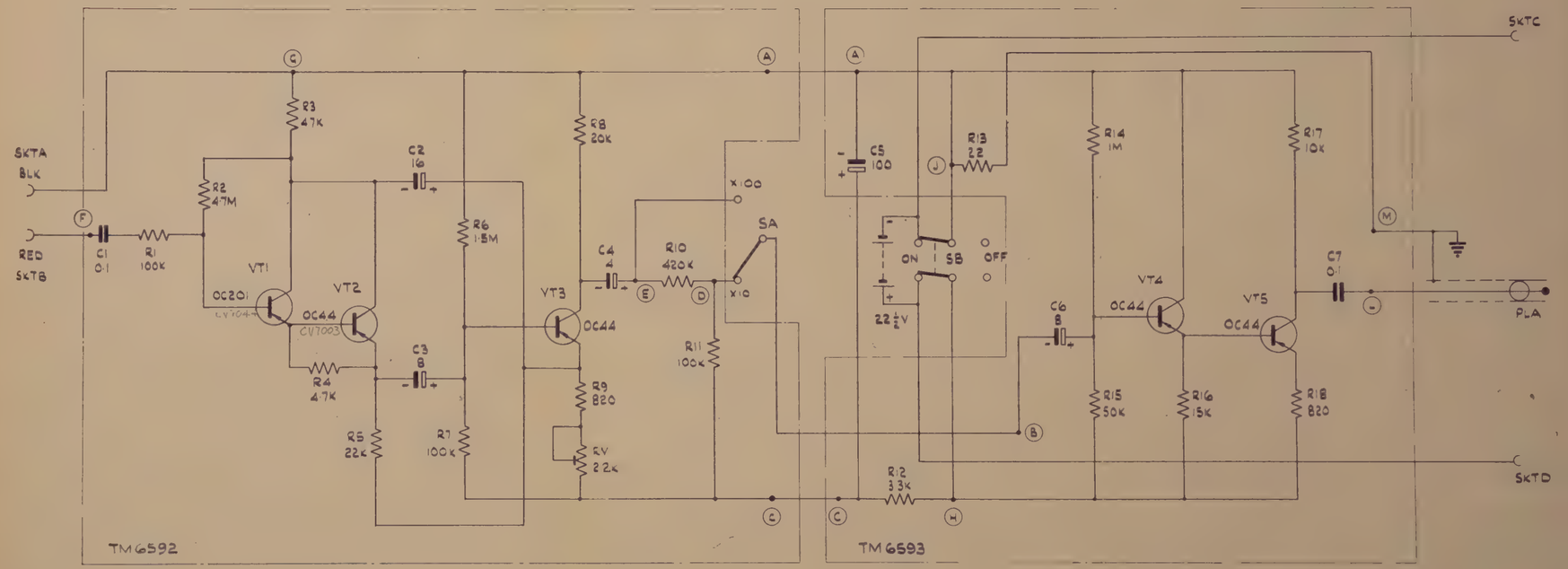
The voltages given in this section, for guidance when servicing the instrument, are indicative of the readings obtained when using a 20,000 ohms-per-volt meter. It must be noted that wide production spreads are encountered in the manufacture of transistors and the voltage indications given in the table should be regarded as representative only; variations do not necessarily indicate the malfunctioning of a stage.

4.6 (continued)

All voltages shown in the table below are volts d.c. relative to the battery negative.

Transistor	Collector	Base	Emitter
VT1	7	11.5	13
VT2	7	13	15
VT3	7*	17	19*
VT4	0	19	20.5
VT5	9	20.5	21

* Voltage depends upon the setting of RV1



•Ⓐ INDICATES SOLDER TAG ON CONDUCTOR SIDE OF PRINTED BOARD

TITLE

3c/s - 100kc/s PRE-AMPLIFIER CIRCUIT DIAGRAM

DRAWN	DATE	CHKD.	APPD.	TRC'D.	ASSEMBLY	STOCK LIST	DRAWING NUMBER
B. MIDDLE	10-1-61	T		E.M.T.	TD35160	TM6591	XD35176

MARCONI INSTRUMENTS LTD. SHEET OF 1 SHEETS

XD 35176

ISSUE NO.

CIR. REF.	DESCRIPTION	GRID	STOCK LIST REF.	CIR. REF.	DESCRIPTION	GRID	STOCK LIST REF.
R1	100K ± 10% ½W	E3	6 TM 6592	C1	0·1μF ± 20% 600V	D3	25 TM 6592
R2	4·7M ± 10% ½W	E3	7 TM 6592	C2	16μF +100% -20% 25V	F2	26 TM 6592
R3	47K ± 10% ½W	E2	8 TM 6592	C3	8μF +100% -20% 12V	F4	27 TM 6592
R4	4·7K ± 10% ½W	F4	9 TM 6592	C4	4μF ± +100% -20% 25V	G3	28 TM 6592
R5	22K ± 10% ½W	F4	10 TM 6592	C5	100μF +100% -20% 25V	H2	29 TM 6592
R6	1·5M ± 10% ½W	F3	11 TM 6592	C6	8μF ± +100% -20% 12V	K3	21 TM 6593
R7	100K ± 10% ½W	F4	6 TM 6592	C7	0·1μF ± 20% 350V	L3	22 TM 6593
R8	20K ± 2% ½W	G2	12 TM 6592				
R9	820Ω ± 10% ¼W	G4	13 TM 6592				
R10	420K ± 1% ½W	G3	14 TM 6592				
R11	100K ± 2% ½W	H3	15 TM 6592				
R12	3·3K ± 10% ½W	J5	6 TM 6593				
R13	220 ± 10% ½W	J3	7 TM 6593	VT1	OC 201	E3	34 TM 6592
R14	1M ± 10% ½W	K2	8 TM 6593	VT2	OC44	F3	33 TM 6592
R15	50K ± 1% ½W	K4	9 TM 6593	VT3	OC44	G3	32 TM 6592
R16	15K ± 10% ½W	K4	10 TM 6593	VT4	OC44	K3	29 TM 6593
R17	10K ± 2% ½W	L3	11 TM 6593	VT5	OC44	L3	29 TM 6593
R18	820Ω ± 2% ½W	L4	12 TM 6593				
				SA	D.P.D.T.	H3	35 TM 6591
				SB	D.P.D.T.	J3	35 TM 6591
RV1	2·2K PRE-SET ½W	G4	16 TM 6592				

DRAWN B.MIDDLE.	CHKD	USED ON TM 6591	COMPONENT LIST
DATE 5.2.61.	APPD.	SHT. 1 OF 2 SHTS.	XD 35176
TRACED PKY	MARCONI INSTRUMENTS LTD.		

100-1000/M59

24 NOV 1961
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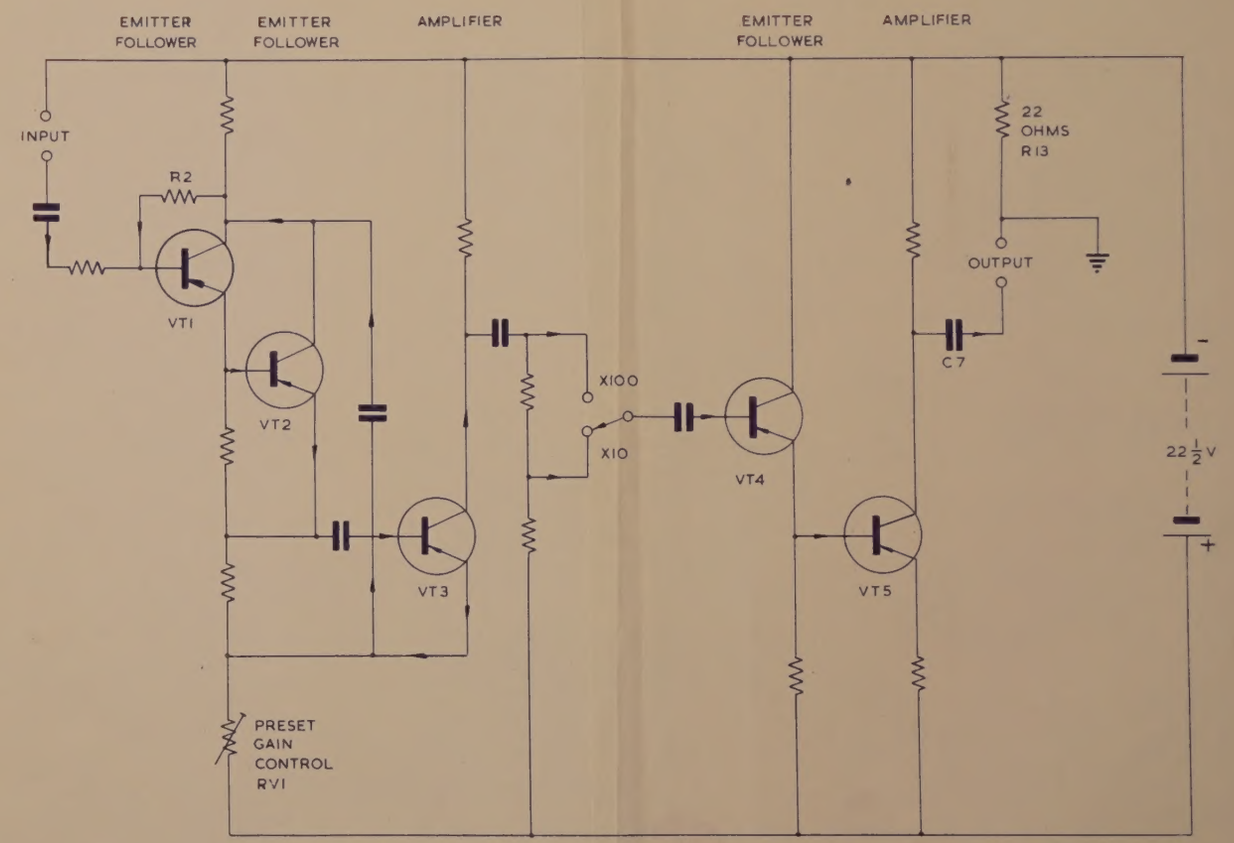
ISSUE NO.

CIR. REF.	DESCRIPTION	GRID	STOCK LIST REF.	CIR. REF.	DESCRIPTION	GRID	STOCK LIST REF.
PLA	CO-AXIAL 83- 1SPN	M3	29 TM 6591				
SKTA		D2	31 TM 6591				
SKTB		D3	32 TM 6591				
SKTC		M1	33 TM 6591				
SKTD		M4	33 TM 6591				

DRAWN B.MIDDLE.	CHKD	USED ON TM 6591	COMPONENT LIST XD 35176
DATE 6.2.61.	APPD.	SHT. 2 OF 2 SHTS.	
TRACED PKY	MARCONI INSTRUMENTS LTD.		



TITLE FUNCTIONAL DIAGRAM OF 3-c/s TO 100-kc/s PRE-AMPLIFIER	DRG. No. TLC 35865
MARCONI INSTRUMENTS LIMITED	SHEET 1 OF 1 SHEETS

DRG. No. TLC 35865	ISS. 2

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Printed in England 2½K 9/61 BWL